



# Below and aboveground pigeonpea productivity in a novel doubled-up legume cropping system across three agro-ecologies in central Malawi

Chiwimbo Gwenambira<sup>1</sup>, Regis Chikowo<sup>1</sup>, Sieglinde Snapp<sup>1</sup> and Bekunda Mateete<sup>2</sup>

<sup>1</sup>Plant, Soil, and Microbial Sciences Dept., MSU <sup>2</sup>International Institute of Tropical Agriculture (IITA), Africa RISING, Arusha, Tanzania

## Background

- The doubled-up technology is a new innovation which involves intercropping two compatible grain legume crops
- The system is hinged on the initial slow growth of one of the legumes facilitating growth of companion crops as if sole cropped
- Pigeonpea, a semi-perennial legume is suitable for doubled-up cropping systems (Figures 1 and 2)
- The shrubby legume is a key component for nutrient cycling mainly because of its deep roots
- Despite past research on grain legumes in Africa, empirical data on root and shoot biomass additions through shrubby legumes has largely remained scarce

## Objectives

- To determine aboveground and belowground biomass of pigeonpea in doubled-up legumes involving groundnut and soyabean
- To determine aboveground and belowground biomass of pigeonpea in pigeonpea/maize intercrops

## Hypothesis

- Integrating pigeonpea with other grain legumes results in more above and below ground inputs and in long term sustainable intensification

## Methods

- Field experiments were set-up in three agro-ecologies in central Malawi, during the 2013/14 cropping season.
- Pigeonpea was planted as a sole crop or in an additive intercrop system with groundnut, soyabean or maize.
- Six months after planting, representative pigeonpea plants across treatments were cut at ground level
- Aboveground components were separated into stems, twigs, leaves and pods
- Senescent leaf litter was collected using traps
- Roots were excavated from 0-20 cm, 20-40 cm and 40-60 cm layers
- Soil sampling: Potentially Mineralizable N (PMN), Inorganic N, pH, texture



Figure 1.  
Pigeonpea and maize cropping system



Figure 2.  
Pigeonpea and groundnut doubled-up cropping system



Figure 3.  
Aboveground and belowground biomass determination methods.

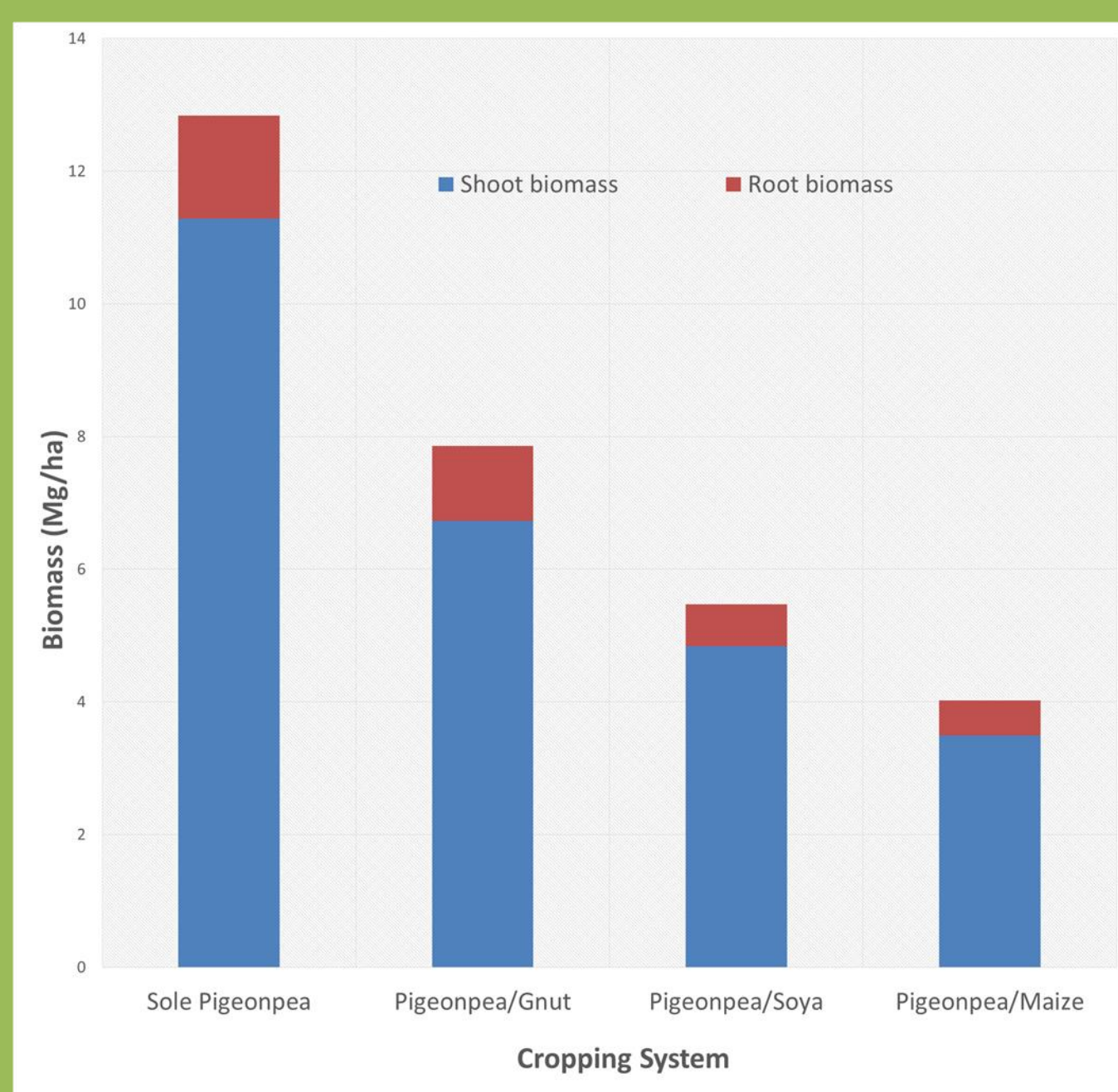


Figure 4.  
Shoot and root biomass of pigeonpea in four cropping systems

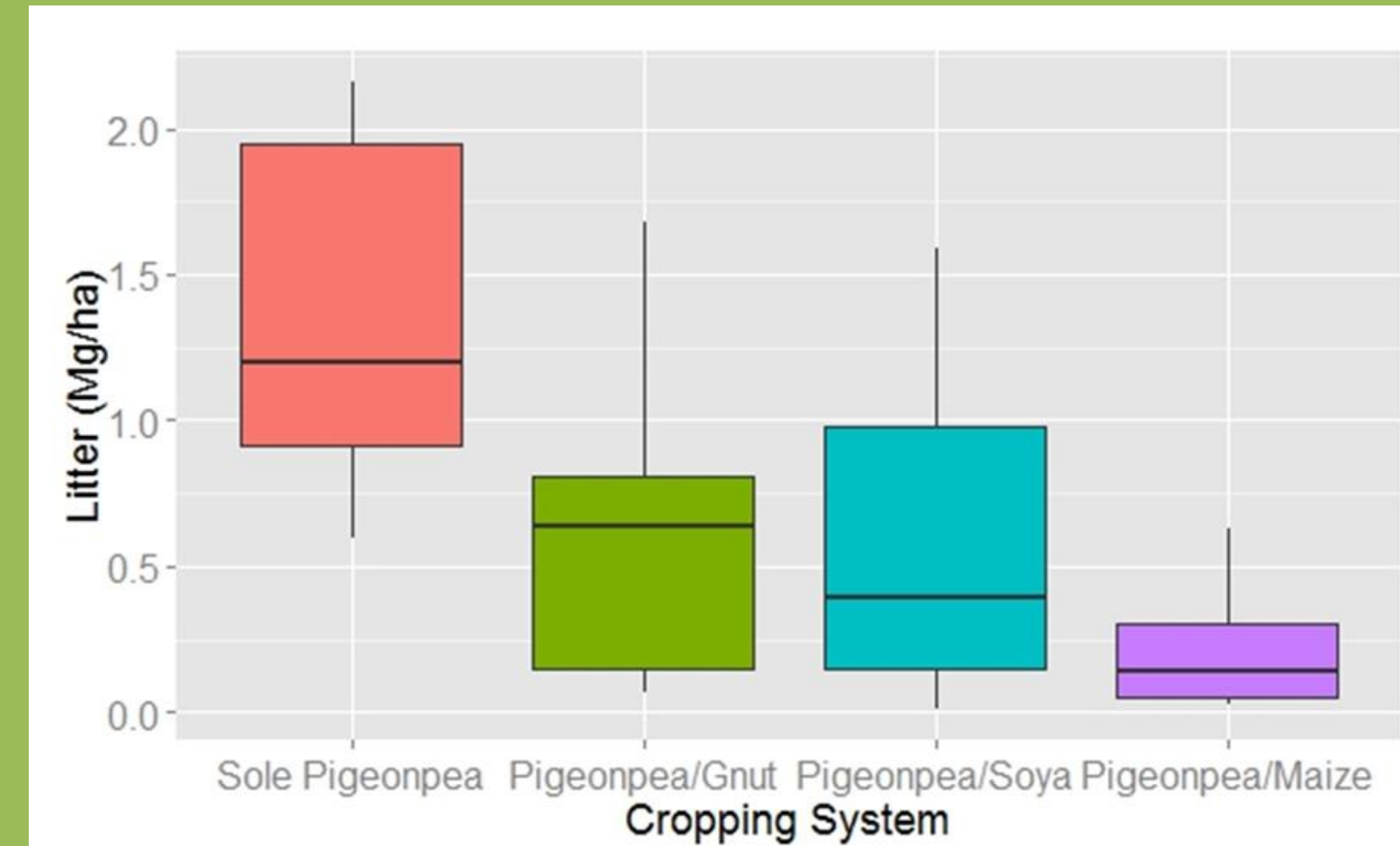


Figure 5.  
Total litter of pigeonpea in four cropping systems throughout the growing season

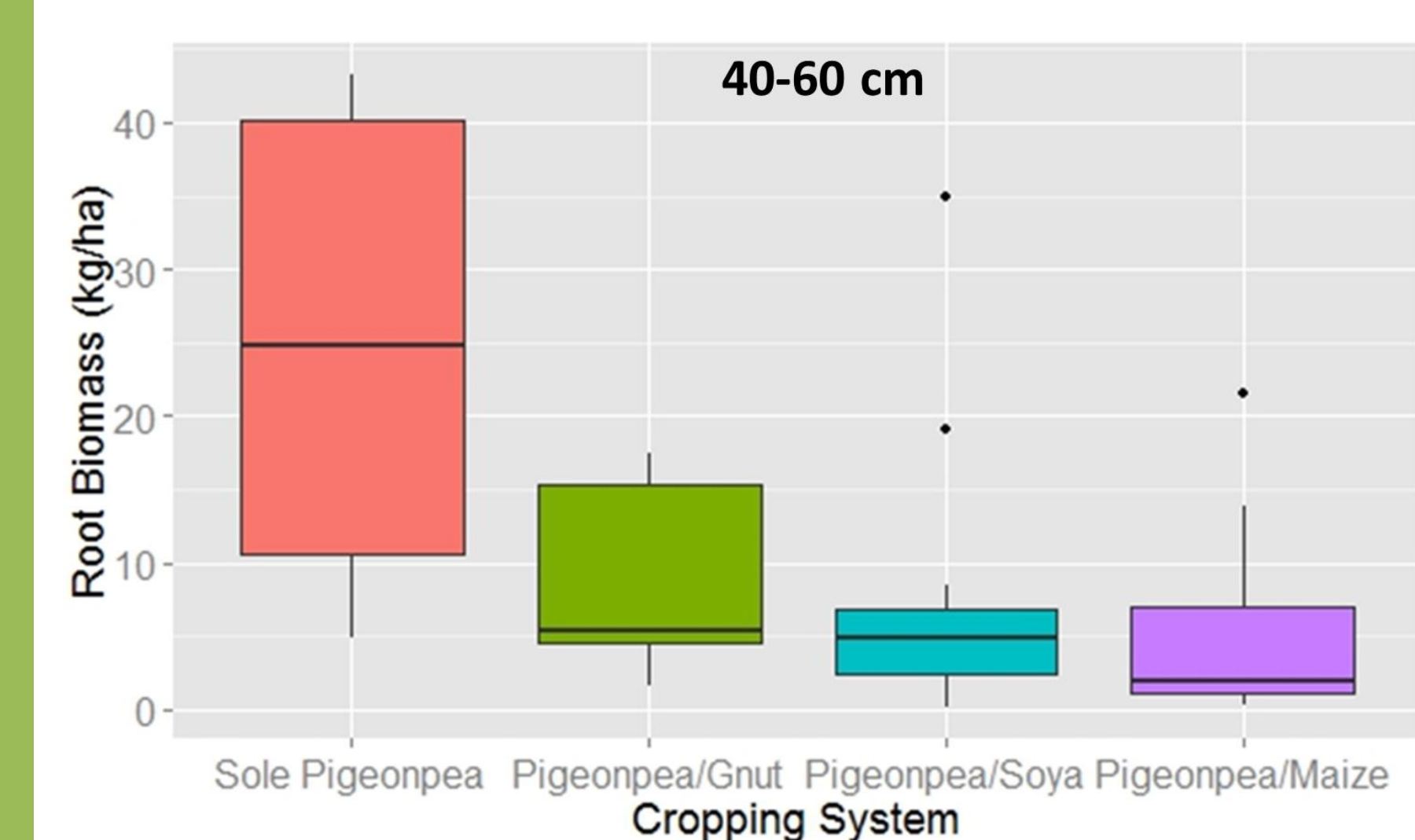
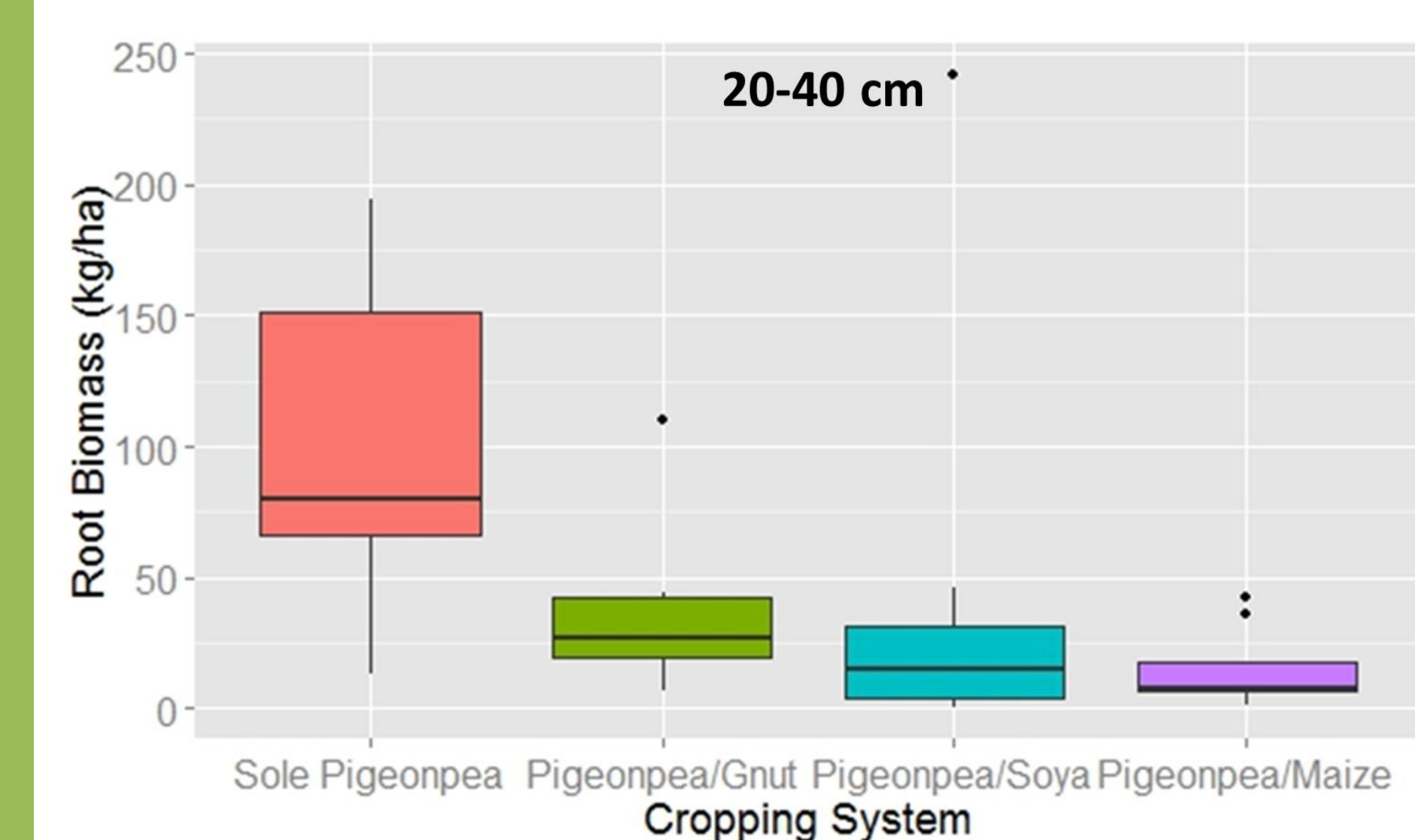
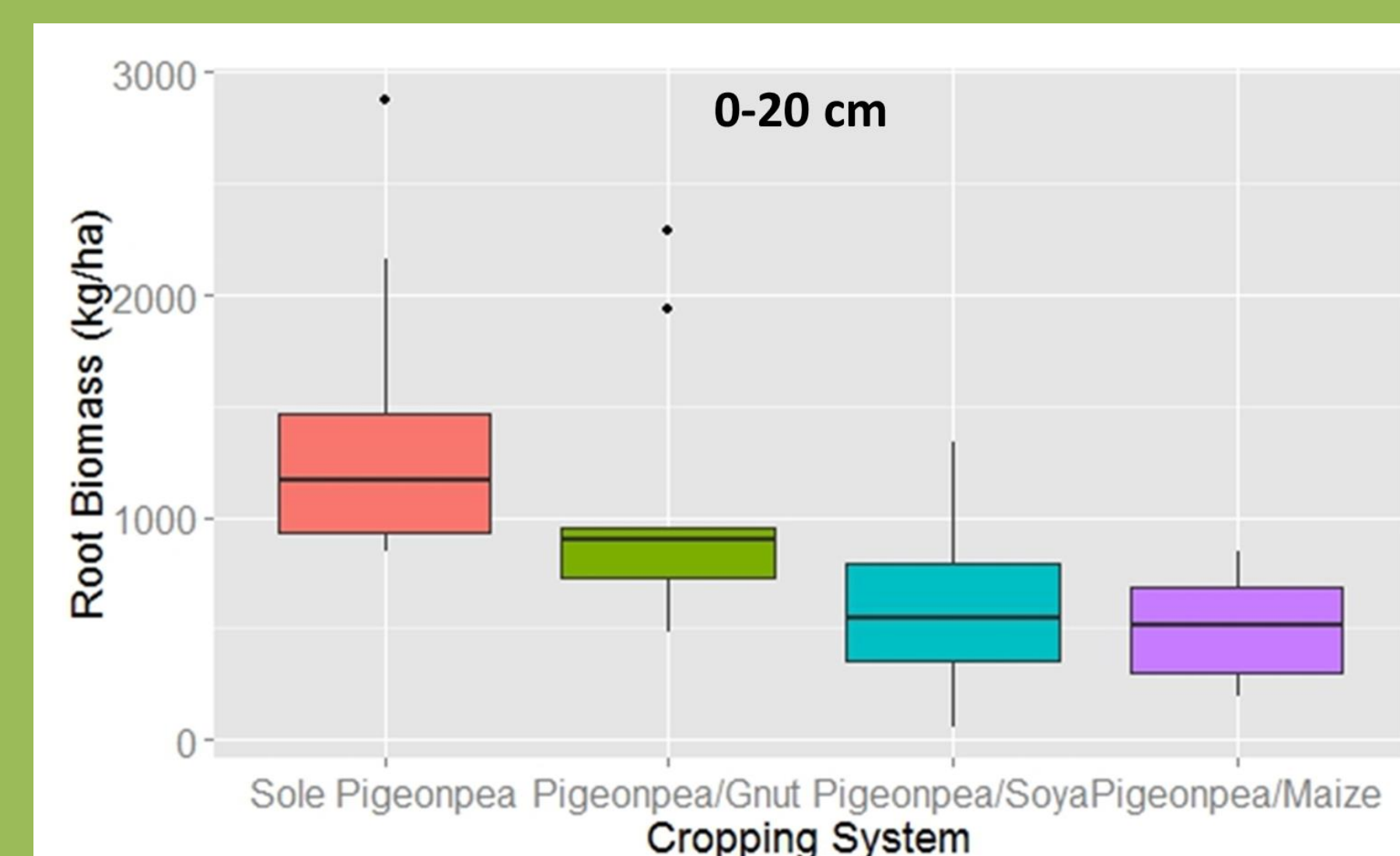


Figure 6.  
Root biomass of pigeonpea in four cropping systems from 0-20 cm, 20-40cm and 40-60 cm depths. Please note that the scale is different

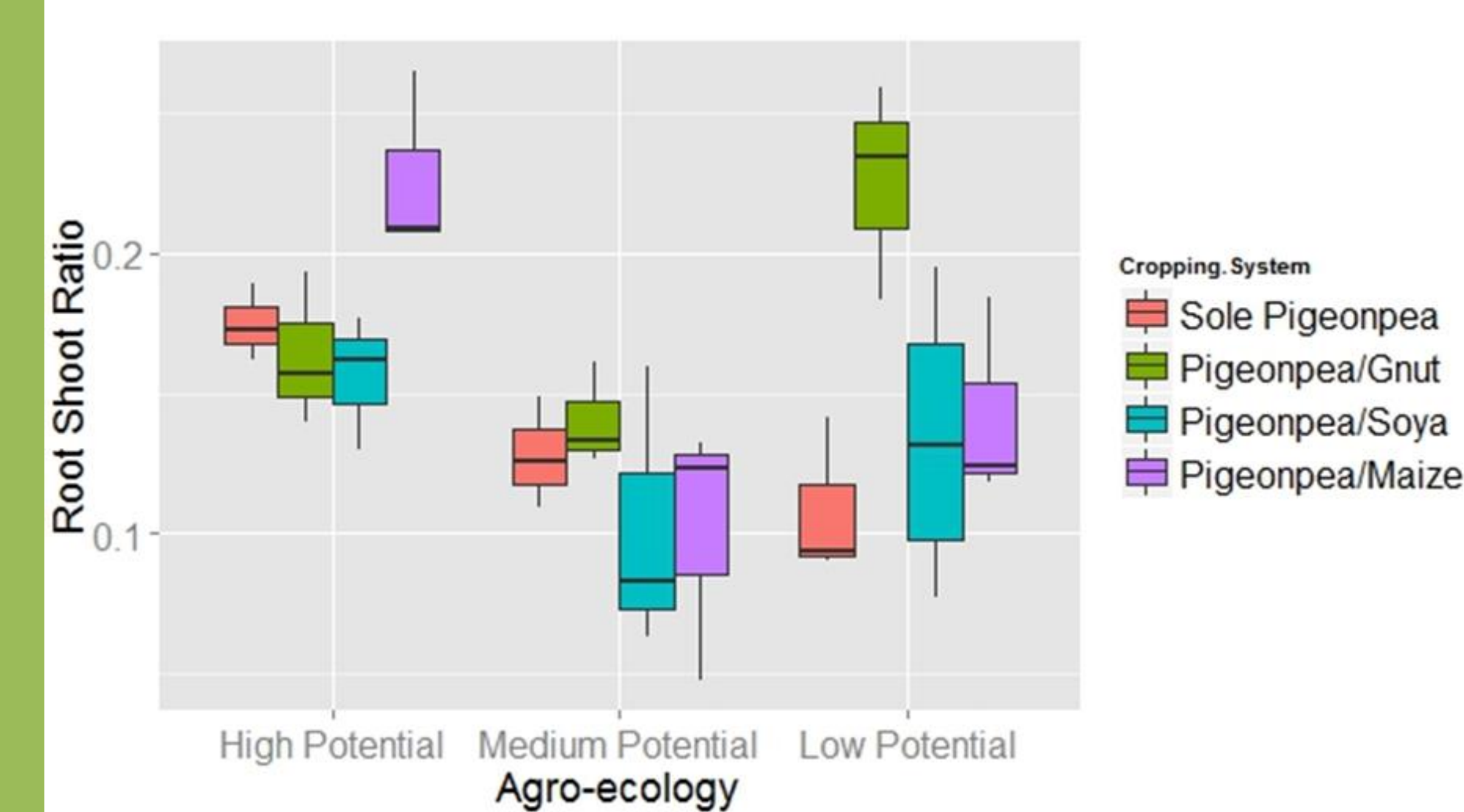


Figure 7.  
Root to shoot ratios of pigeonpea in three agro-ecologies and cropping systems

## Results

- Across sites, pigeonpea above ground biomass was largest for sole pigeonpea and lowest for the pigeonpea/maize intercrop (Figure 4)
- Leaf litter was highest for sole pigeonpea and lowest for the pigeonpea/maize intercrop (Figure 5)
- Root biomass was largely confined in the 0-20 cm layer, with trends similar to that for shoot biomass (Figure 6)
- At below the 20 cm depth, fine pigeonpea roots were dominant (Figure 6)
- Root shoot ratios varied with agro-ecologies and cropping systems (Figure 7)

## Conclusions

- Intra-specific competition in a well fertilized pigeonpea and maize intercropping system is rather large
- Pigeonpea productivity in a pigeonpea/groundnut system is comparable to sole cropped pigeonpea, with additional grain benefits.
- The Africa RISING program is promoting the doubled-up legume system for enhanced land productivity on smallholder farms.

Further thoughts/questions:

- What are the nutrient budgets of the different pigeonpea based doubled-up cropping systems?

## Acknowledgements

Many thanks to Africa RISING, USAID and all of their partners